Space programmes supporting energy challenges

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2. Space at the service of energy challenges
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4. The "Space & Energy" activities at ESA
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    b. Initial pilot actions proposed
5. Short-time steps
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ENERGY CHALLENGES

- Improve efficiency of energy usage
- Limit global warming
- Reduce needs of expendable resources
- Increase offer and use of renewable resources
- Ensure energy supply for all
- Ensure security of supplies
- Support operations of energy actors
- Support development
- Enforce energy policies (at local, regional, national and supra-national levels)

SPACE AT THE SERVICE OF ENERGY CHALLENGES

- Satellite services and space technologies contribute already in some pilot areas to solve energy challenges but they can be developed and extended
- Space and energy represent:

Different actors,

different markets,

different research practices

Both strategic,

both with need of public intervention,

both requiring long-term planning, and

very significant investments

SPACE AT THE SERVICE OF ENERGY CHALLENGES

- Understanding the "energy" question on Earth and the potential benefits space programmes and data can bring as a "tool"
- Exploring synergies and cooperation between energy and space technologies
- Given the features of Space research and technologies
    - Excellence, knowledge and track-record of achievements
    - Innovation, spreading over many sectors – growth and jobs
- Analysing policies (in particular with the EU) to identify most relevant areas
- Proposing pilot projects coming from all areas of space projects and coordinated via an inter-Directorate project
    - Satellite services for energy
    - Energy space technologies

SATELLITE SERVICES FOR ENERGY

- map RES resources;
- manage RES power plants;
- monitor thermal efficiencies of building;
- supervise large and critical energy infrastructure;
- enforce energy legislation

ENERGY SPACE TECHNOLOGIES

- space solar panels;
- advanced power control devices;
- batteries, radio-isotope power sources and fuels cells;
- advanced power trains, fuels, fuel tanks (e.g. hydrogen);
- super-insulating materials;
- computing facilities

SUPPORT TO EU POLICIES AND CHALLENGES

Used for the establishment of "Space & energy" proposals (EU policies and challenges listed in annex)

a. Technology challenges for 2020 targets
b. Technology challenges for 2050 targets
c. EU SET-Plan (Strategic Energy Technologies) Roadmap on Low Carbon Energy Technologies

ESA FUTURE & STRATEGIC STUDIES

1. General Studies Programme (app 30 M€/year)
    a. Mission studies for ESA programmes (Phases A)
    b. Interdisciplinary studies (foll. Internal Call for Ideas)
    c. Strategic studies
    d. www.esa.int/SPECIALS/GSP/
2. Advanced Concepts Team
    a. Potential fields 25-30 years ahead
    b. In-house research group (self and Ariadna)
    c. Research networks
    d. www.esa.int/gsp/ACT/index.htm
3. Transverse activities
    a. Coordination at corporate level

TRANSVERSE ACTIVITIES

1. Why: ensuring coordination of activities that concern several Directorates
2. What (today):
    a. Exploration
    b. Space & the Arctic; Space & the Antarctic
    c. Space & Energy
3. Who: ESA Policies, Planning & Control Directorate + representatives of other concerned Directorates + MS, EU and/or partners
4. How: internal WG, cross-information, WS, information to MS, EU and partners
5. For what:
    a. Global coordination and knowledge
    b. Preparation of future programmes / activities

SPACE & ENERGY ACTIVITIES AT ESA (1/2)

- Creation of an Inter-directorate Working Group in 2009
- Representatives of 6 different Directorates under the coordination of the ESA Policies, Planning & Control Directorate: Earth Observation, Telecommunications & Integrated Applications, Human Spaceflight & Operations, Science, Technology,
- Understanding of the "energy" question on Earth and of the potential benefits space programmes and data could bring as a "tool"
- Review of EU policies concerning energy and the relevance to space programmes and applications
- Identification of 15 candidate pilot projects submitted to EC DG-TREN (now DG-ENER) in 2009 (*next slide*)
- Discussions with EC DG ENER

SPACE & ENERGY – INITIAL PILOT ACTIONS PROPOSED

1. Enhanced heat exchangers
2. c-Si Photo Voltaics
3. Diffusion and Soret Coefficients
4. EO services in support of Sustainable Low-Carbon Energy Production & Use
5. Innovative practices for energy efficiency in buildings
6. High Efficiency solar cells: transfer of know-how and conversion technology
7. Integrated space and terrestrial solar power plant system
8. Intelligent Integrated Grid Monitoring & Control
9. Intelligent Planning, Monitoring and Diagnostics
10. Pipeline Remote Monitoring System
11. Prediction of Disruptive Geomagetically Induced Currents in Large Scale Electrical Networks
12. Solid nano-structures metal powder fuel
13. Small-Scale Power Plant Management & Integration with Electricity Grid
14. Space Infrastructures as enabling factor to increase the safety of end-to-end energy production
15. Lightweight high-efficiency thermoelectric material converting waste heat into electricity

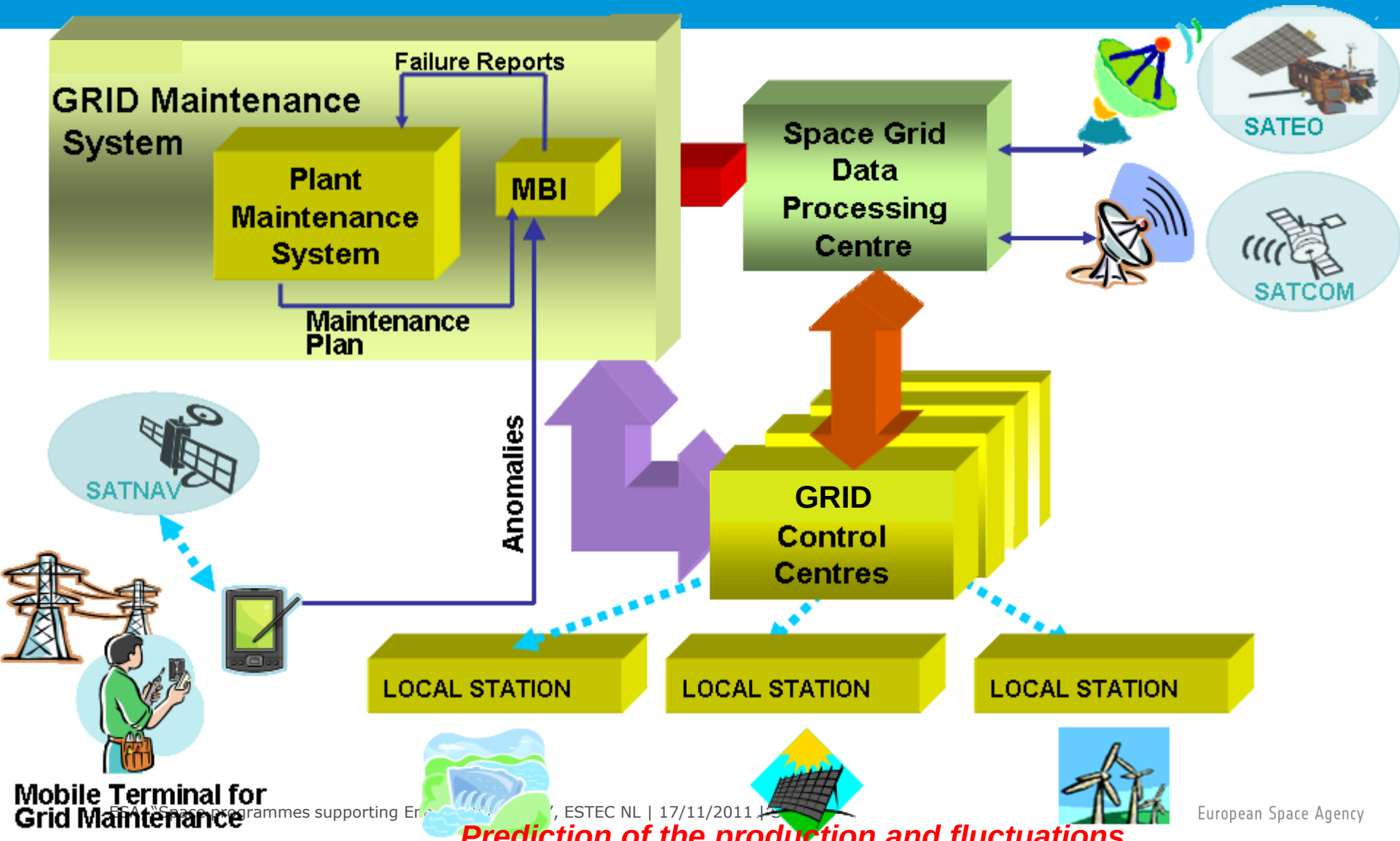
SPACE & ENERGY ACTIVITIES AT ESA (2/2)

- Project presented to the EU FP7 Energy Programme Committee in October 2009 with a joint EC/ESA presentation
- ESA/EC Workshop in January 2010 which gathered more than 50 persons:
    - Representatives of some 10 MS of ESA and EC-Energy
    - Experts in energy
    - Experts from ESA and EC Directorates concerned
    - Recommendations issued (*next slide)*
- Identification by EC beginning 2011 of priority activities on solar energy
    - High-efficiency solar cells: Transfer of know-how and conversion technology
    - Integrated space and terrestrial solar power plant system
- Inclusion of these elements in the FP7 Call 5 (Space) issued in 2011

EC/ESA 2010 WORKSHOP - RECOMMENDATIONS

1. On Policy enforcement: Bio-fuels, Energy efficiency, CO2 storage, Monitoring of infrastructure projects and Applications in transport
2. On Applications for energy system management: Mapping of renewable energy resources, Carbon Capture & Storage and Smart Grids
3. On Technology Transfer: Robotics, Materials, Energy storage, Monitoring and maintenance. Priorities in TT have been identified for:
    1. Energy storage for Renewable energy sources and vehicles
    2. Thermo control technologies
    3. Advanced materials
4. For Long-term research, large areas of potential collaboration have been identified. It has been recommended to build links with European research organisations, for detailed expert discussions to define an R&D programme

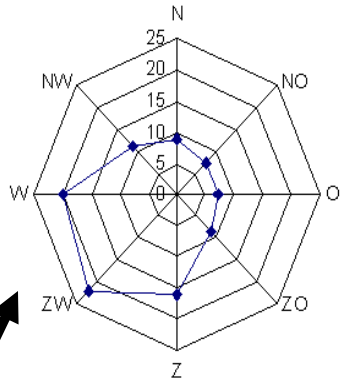
SPACE GRID ARCHITECTURE



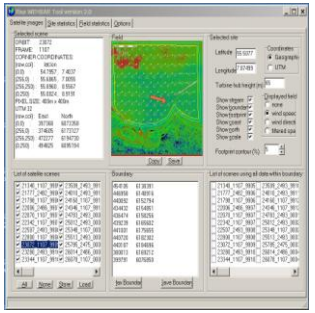
Prediction of the production and fluctuations of the Renewable Energy Sources (RES)

RENEWABLE ENERGY : WIND

Wind rose



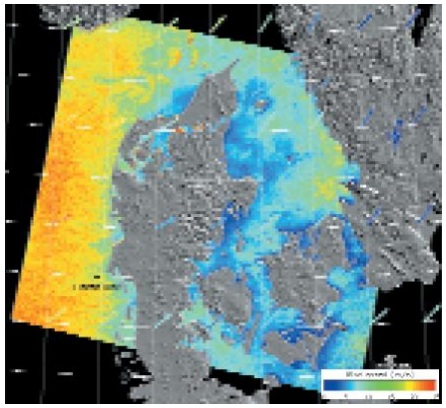
Industry software for **resources estimation**



Risø DTU
National Laboratory for Sustainable Energy

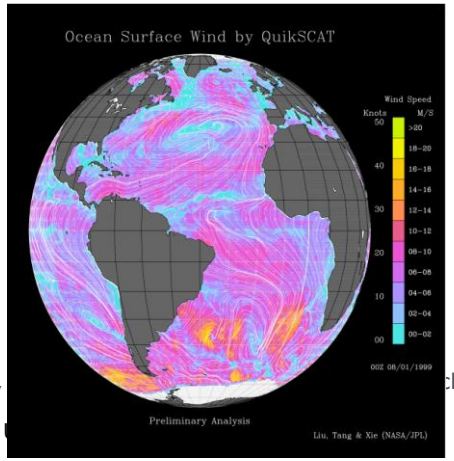
Vestas

High-res Regional Radar



>15 years archived history is crucial

Low-res Global Scatt

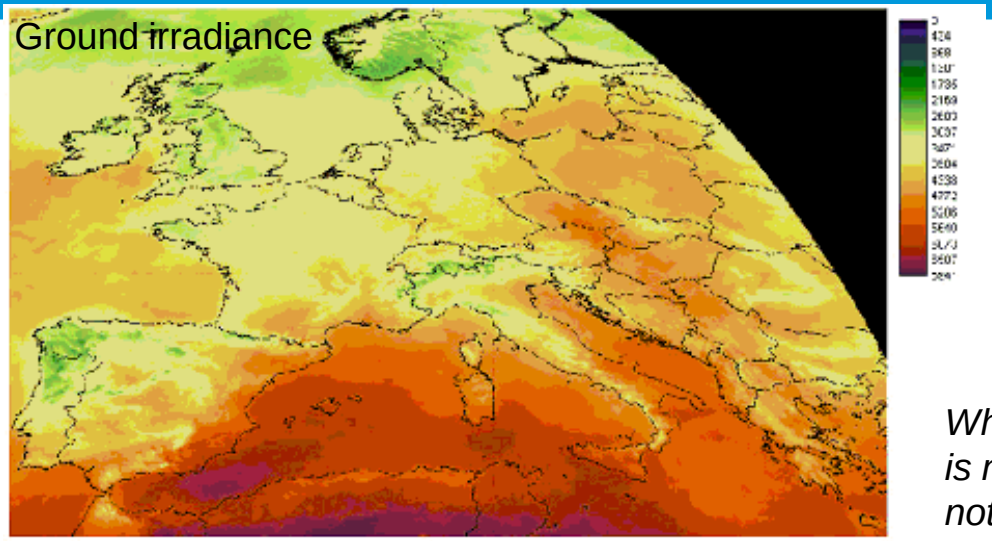


N·E·G MICON®
Powerful Simplicity

World's largest turbine manufacturer for **planning & maintenance of turbines**

Courtesy RISOE

RENEWABLE ENERGY : SOLAR



Dem Sonnenschein auf der Spur

von Ole Neugebauer

Mit Hilfe von Sunshine-Maps finden Solarunternehmen optimale Standorte, um ihre Anlagen möglichst profitabel zu machen. Die Daten dafür stammen aus dem All.

Scheint die Sonne? Ausflüglern reicht für die Antwort ein flüchtiger Blick aus dem Fenster. Will man jedoch eine Solaranlage bauen, braucht man genaue und langfristige Informationen zur Sonnenstrahlung: Deshalb vertiefen sich Ingenieure von Solarunternehmen in bunte Karten aus dem All, in so genannte Sunshine-Maps.

Hergestellt werden diese Karten vom Projekt Envisolar (Environmental Information Services for Solar Energy Industries), einem Verbund europäischer Institutionen und Unternehmen unter der Leitung des

Wo es auf der Sunshine-Map leuchtet ist es warm u

de

nshine-

Maps. Laut ei Unternehmen

er sich

schätzungsweise auf 2,6 Mrd. Euro erhöhen.

Die Daten für die Sunshine-Maps kommen aus dem All: Der europäische Wettersatellit Meteosat

FINANCIAL TIMES
DEUTSCHLAND

EO services for site identification, plant management, grid management, and consulting (architects, urban planning)

Exploiting MSG every 15 min, Envisat for atmospheric correction

When a new market is opened, a site evaluation is not available, as usually other PV-operators do not publish their production values. We are now expanding into countries like Germany, Italy and Spain where we have no operation experiences. Investment costs of about 5 to 12 million Euros are planned. To assure the flow back of these investments we must be sure that we build the PV systems at locations with enough solar radiation. Therefore we will need satellite derived irradiance data.

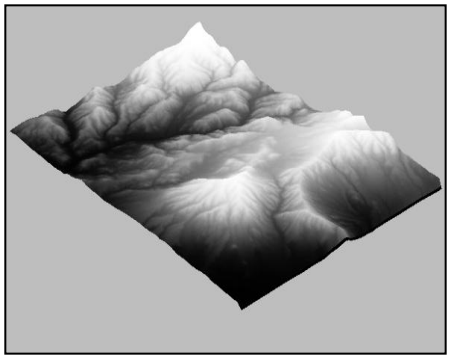
Robert Kröni, Edisun Power AG director

EDISUN POWER

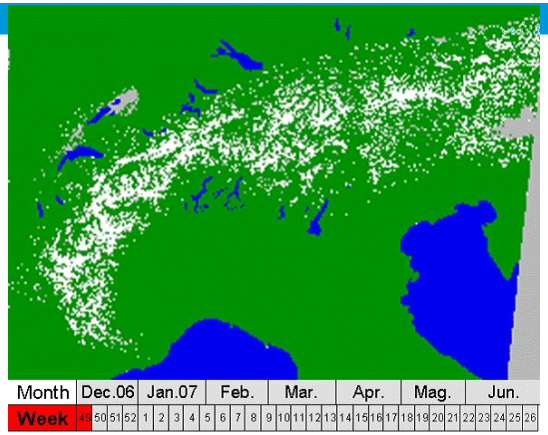
Enel.si L'ENERGIA CHE TI ASCOLTA.
enecolo energy ecology
Solar Millennium

RENEWABLE ENERGY : HYDROPOWER

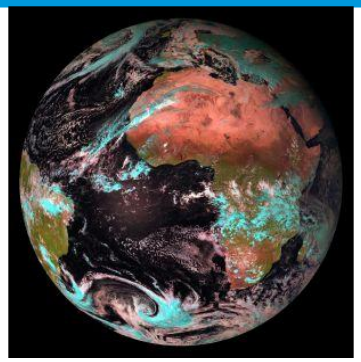
Digital Elevation Model
Land Cover (ENVISAT/SAR)



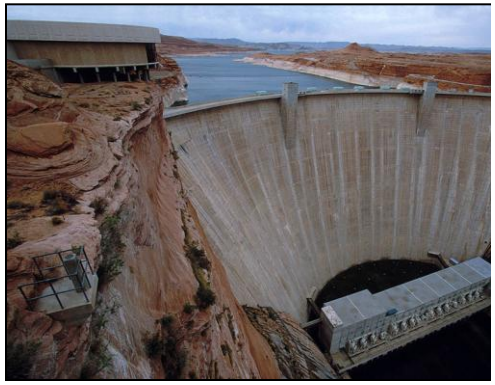
Snow Cover Extent (ENVISAT/MERIS)



Weather Conditions (MSG)

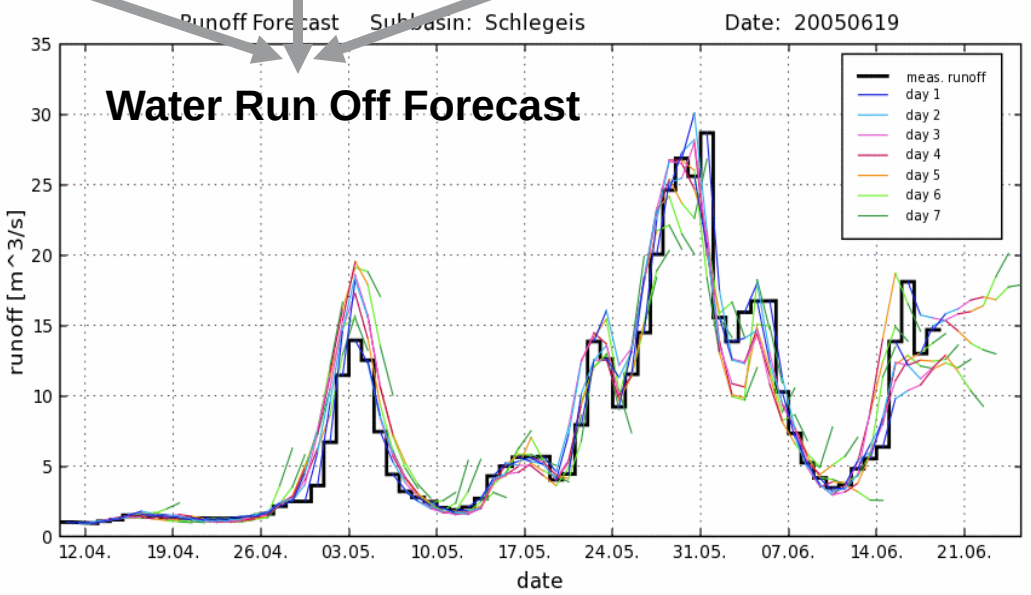


Statkraft Scandinavia



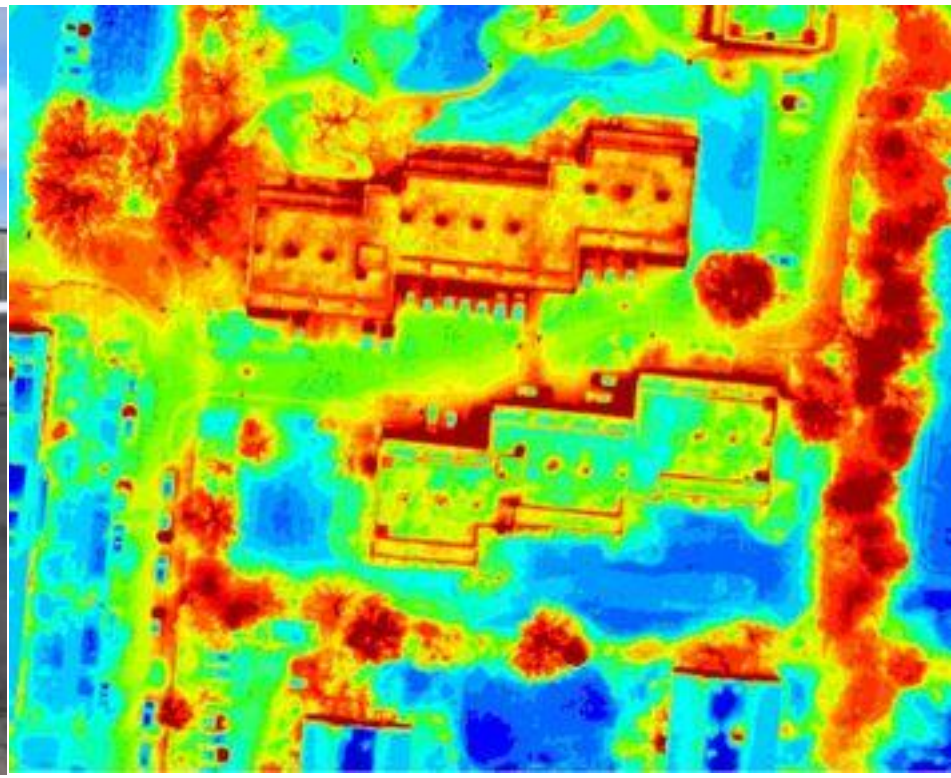
Verbund Austrian Alps

via Hydrological Model



HEAT LOSSES FROM BUILDINGS

MIRAMAP…monitors heat loss from buildings

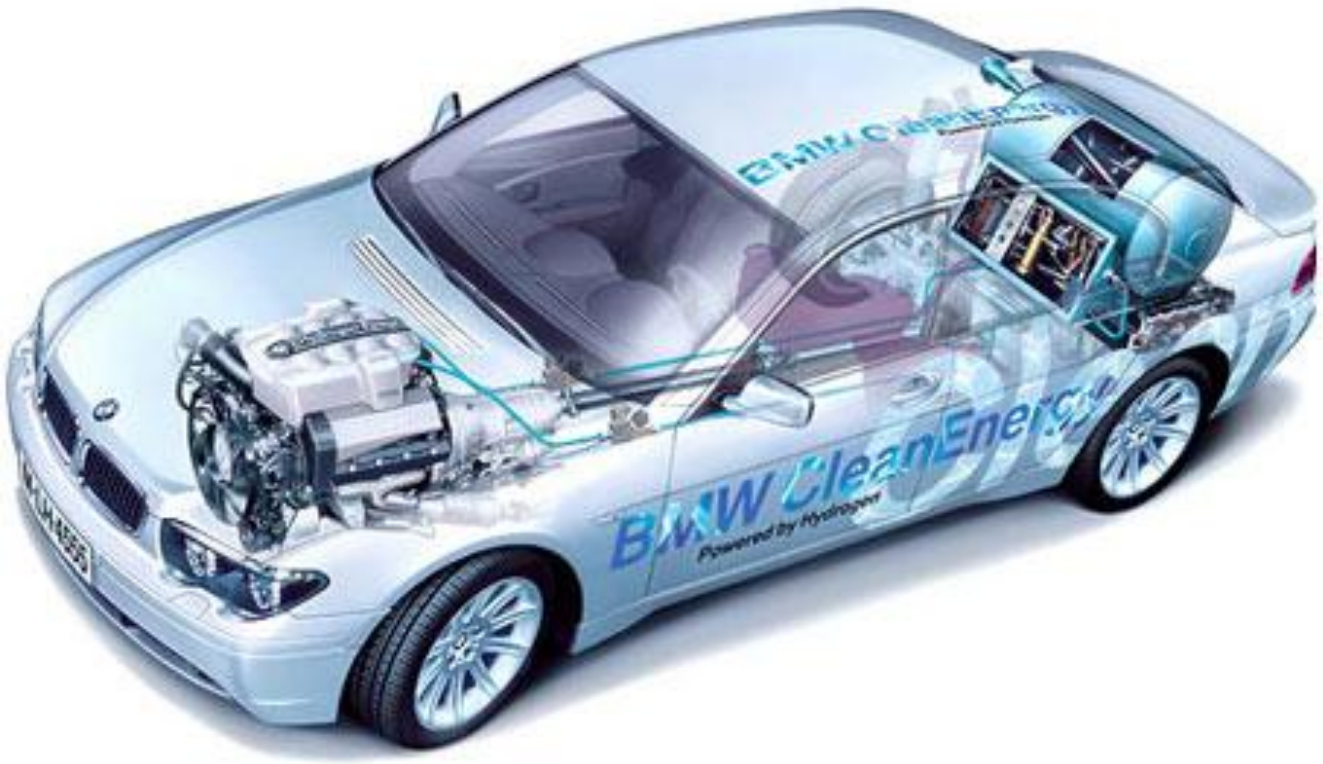


miramap

www.miramap.com/

www.you-rs.com/amsterdam/

TRANSFER: HYDROGEN TANK FOR BMW



SHORT-TIME STEPS

1. Continuously update the potential actions proposed and initiate preparatory work
2. Continue discussions with the EC
3. Elaborate elements of a potential proposal for ESA Member States that could be based on:
    a. Energy technologies e.g.
        - Photovoltaics
        - high-energy density advanced storage technologies,
    b. Infrastructures and equipment for new services
        - Supporting energy-related regulations (including potential high resolution thermal infrared instruments for energy efficiency)
        - Supporting the renewable energy infrastructure, including energy grids, increased efficiency and safety of infrastructure
        - Supporting and complementing terrestrial very large-scale solar power infrastructure projects (type Desertec) e.g. with provision of power from space to reduce expensive storage needs and for power levelling.
4. Organise, at the request of the Bavarian Ministry of Economic Affairs, a symposium in June 2012 on "Energy & Space" with the EC

Thank you for your attention

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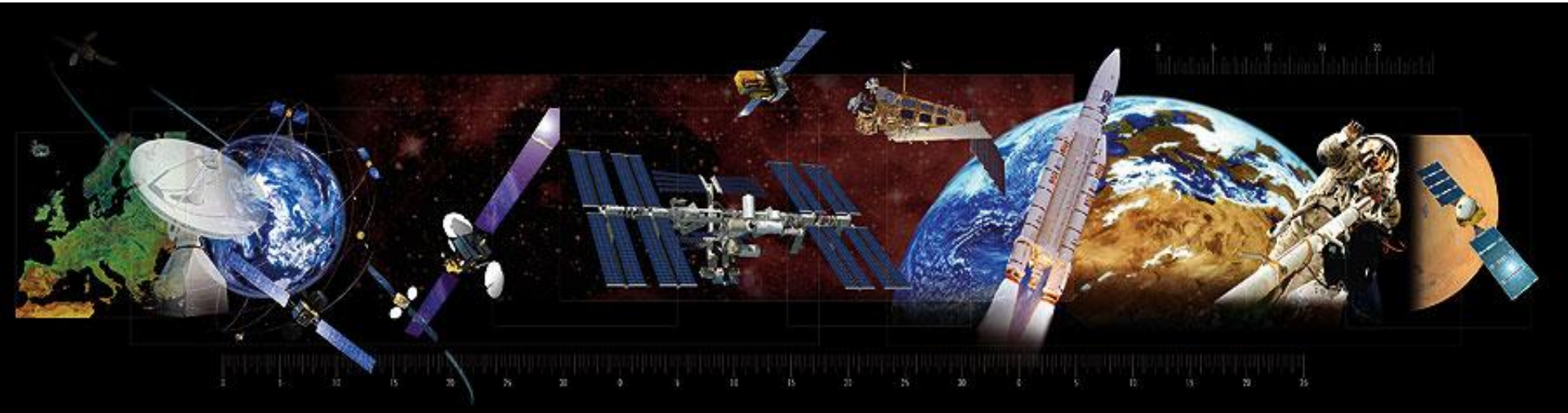

ANNEX

1. Key EU technology challenges for the next 10 years to meet the 2020 targets
2. Key EU technology challenges for the next 10 years to meet the 2050 vision
3. EU SET-Plan Roadmap on Low Carbon Energy Technologies

Key EU technology challenges for the next 10 years to meet the 2020 targets

- **Make second generation bio-fuels competitive alternatives to fossil fuels, while respecting the sustainability of their production;**
- **Enable commercial use of technologies for CO2 capture, transport and storage through demonstration at industrial scale, including whole system efficiency and advanced research**;
- **Double the power generation capacity of the largest wind turbines, with off-shore wind as the lead application;**
- **Demonstrate commercial readiness of large-scale Photovoltaic (PV) and Concentrated Solar Power**;
- **Enable a single, smart European electricity grid able to accommodate the massive integration of renewable and decentralised energy sources**;
- **Bring to mass market more efficient energy conversion and end-use devices and systems, in buildings, transport and industry, such as poly-generation and fuel cells**;
- Maintain competitiveness in fission technologies, together with long-term waste management solutions;

→ *In bold those challenges addressed by one or several of the proposed ESA initiatives*

Key EU technology challenges for the next 10 years to meet the 2050 vision

1. **Bring the next generation of renewable energy technologies to market competitiveness**;
2. **Achieve a breakthrough in the cost-efficiency of energy storage technologies**;
3. **Develop the technologies and create the conditions to enable industry to commercialise hydrogen fuel cell vehicles;**
4. Complete the preparations for the demonstration of a new generation (Gen-IV) of fission reactors for increased sustainability;
5. Complete the construction of the ITER fusion facility and ensure early industry participation in the preparation of demonstration actions;
6. **Elaborate alternative visions and transition strategies towards the development of the Trans-European energy networks and other systems necessary to support the low carbon economy of the future**;
7. **Achieve breakthroughs in enabling research for energy efficiency: e.g. materials, nano-science, information and communication technologies, bio-science and computation**.

→ *In bold those challenges addressed by one or several of the proposed ESA initiatives*

EU SET-Plan Roadmap on Low Carbon Energy Technologies

1. Up to 20% of the EU electricity will be produced by **wind energy technologies** by 2020.
2. Up to 15% of the EU electricity will be generated by **solar energy** in 2020. However if the DESERTEC vision is achieved, the contribution of solar energy will be higher, especially in the longer term.
3. The **electricity grid** in Europe will be able to integrate up to 35% renewable electricity in a seamless way and operate along the "smart" principle, effectively matching supply and demand by 2020.
4. At least 14% of the EU energy mix will be from cost-competitive, sustainable **bio-energy** by 2020.
5. **Carbon capture and storage** technologies will become cost-competitive within a carbon-pricing environment by 2020-2025.
6. While existing nuclear technologies will continue to provide around 30% of EU electricity in the next decades, the **first Generation-IV nuclear reactor** prototypes will be in operation by 2020, allowing commercial deployment by 2040.
7. 25 to 30 **European cities** will be at the forefront of the transition to a low carbon economy by 2020.